The Effects of Elevated Flows on Chum Salmon Spawning Behavior Below Bonneville Dam

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2004 Objectives

1. Determine the flow and tailwater elevation at which ch
   salmon spawning behavior is altered.

2. Determine where fish go in response to high flows and
   when they return to their redds.

3. Determine if normal spawning behavior resumes after
   flow-induced change in behavior.

4. Determine if fish will spawn at higher riverbed elevatio
   as higher flows inundate these areas.

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Possible Behavioral Effects of Elevated Flows on Chum Salmon

- No effect
- Temporary displacement, but return to spawn flows return to normal
- Displacement with spawning elsewhere
- Displacement without continued spawning

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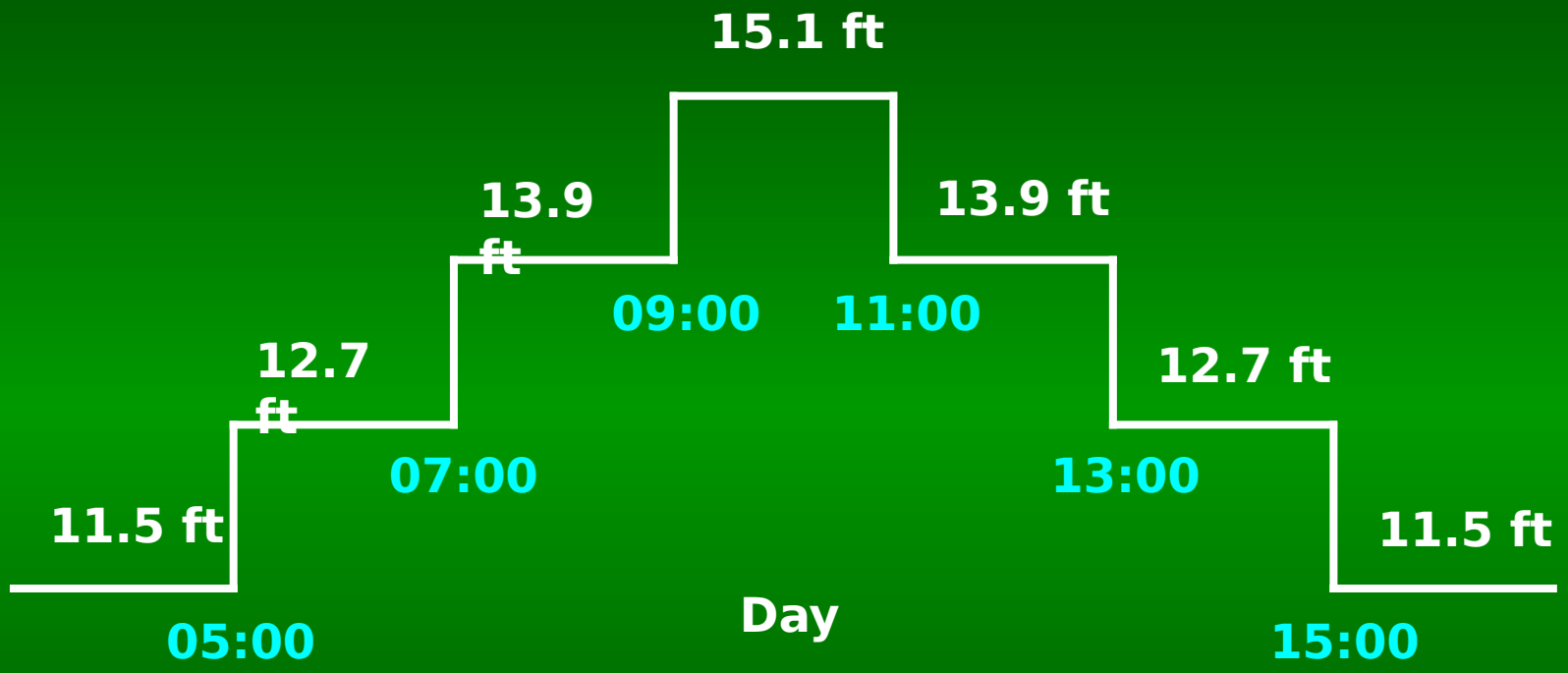
Requested Water Release Pattern



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Hydrophone Setup at Ives Island - 2004

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Acoustic Array

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Fish Collection and Tagging

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Chum redd constructed during
a daytime high-flow test, whic
was subsequently dewatered

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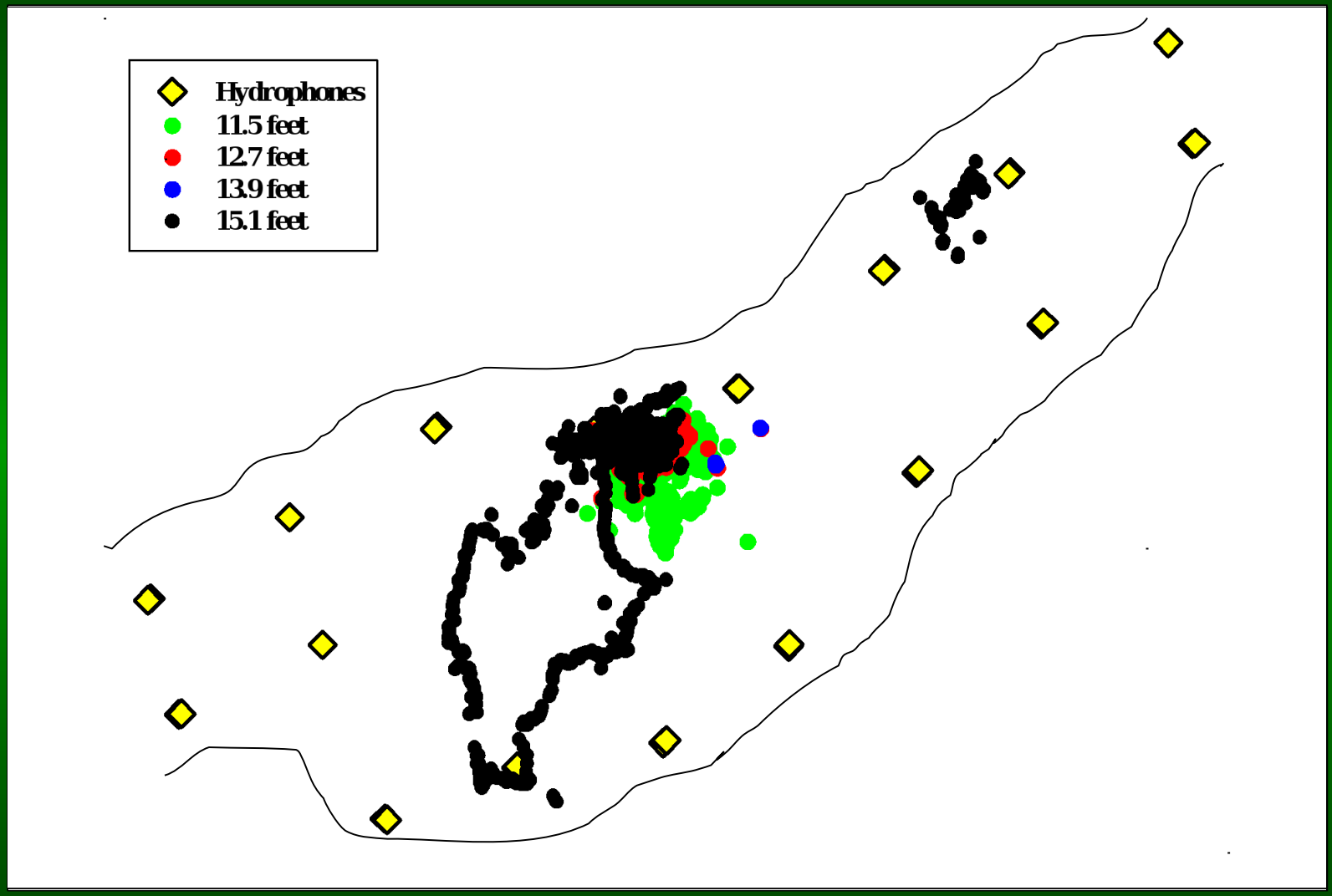
Daytime test – November 17, 2004



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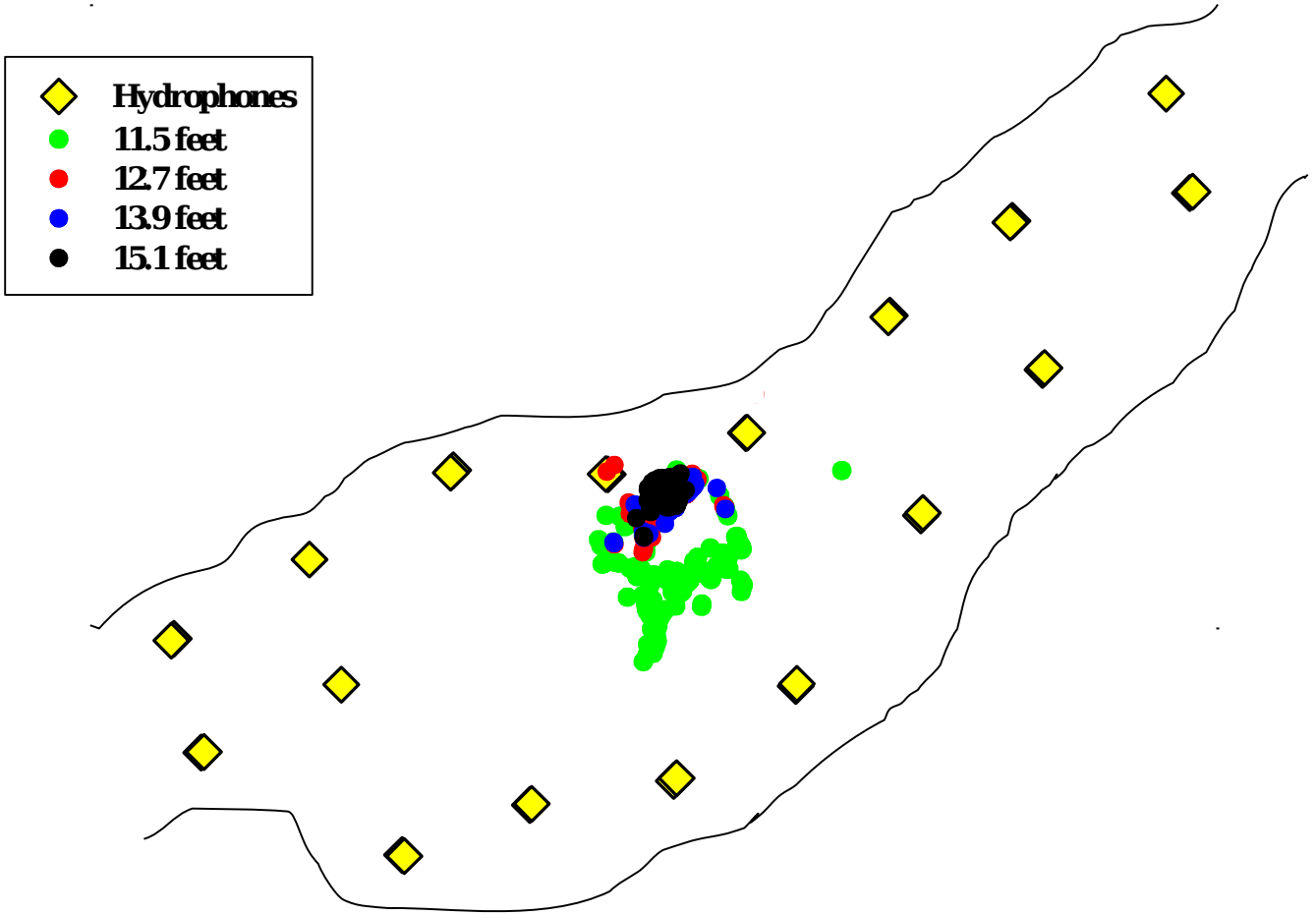
Nighttime test – November 18-19, 2004



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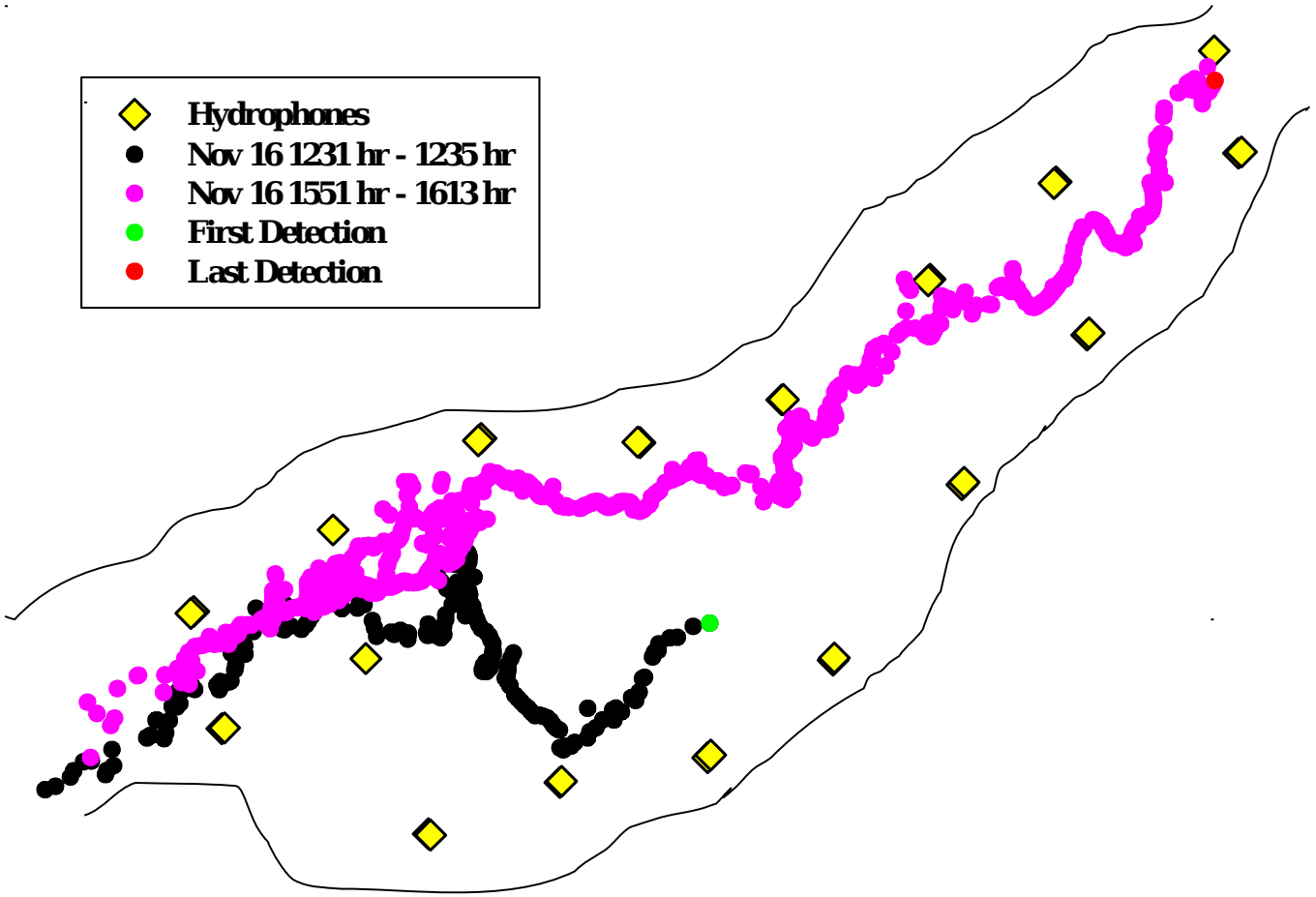
Fish Leaves Array - November 16, 2004



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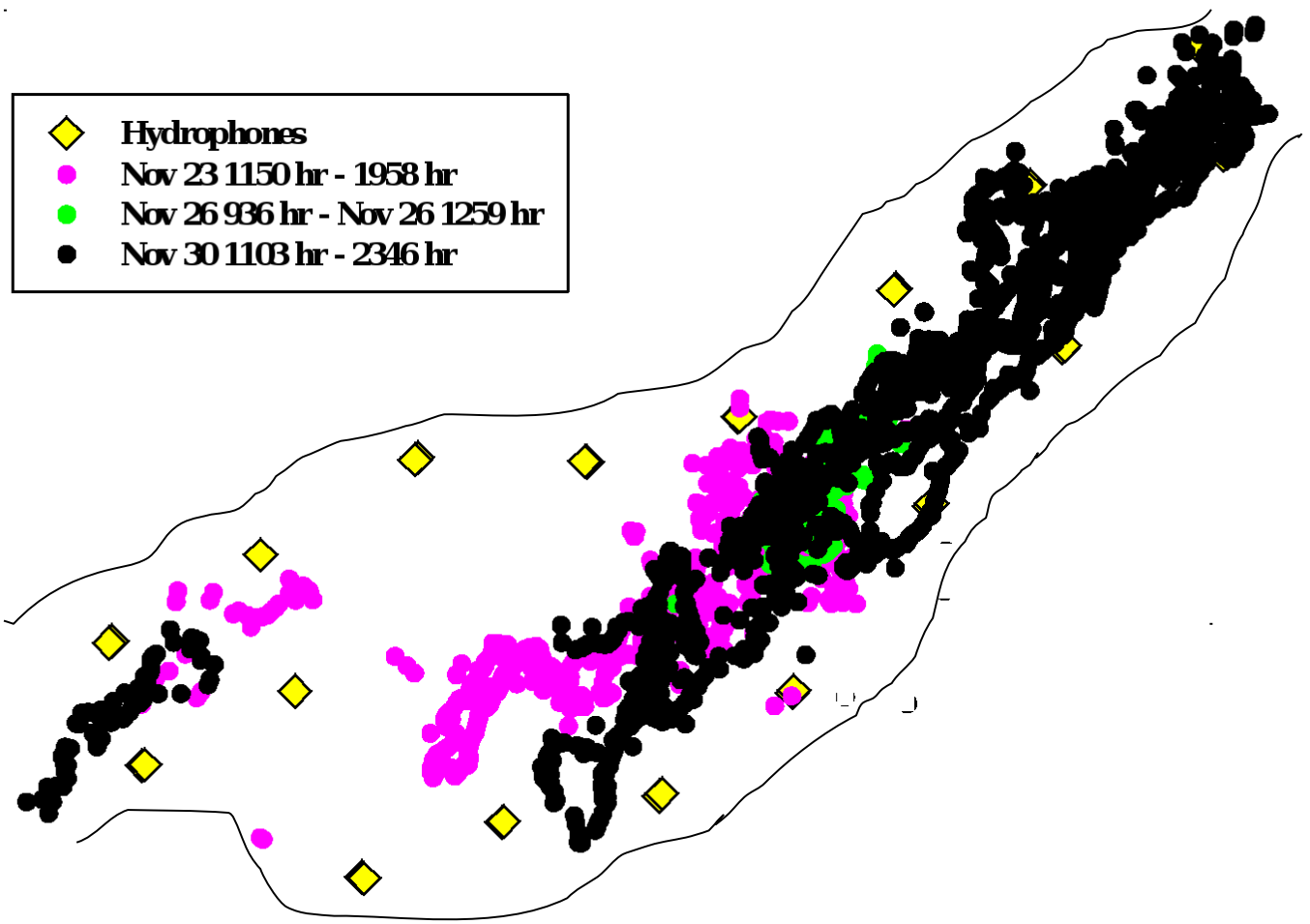
Fish Without a Redd?



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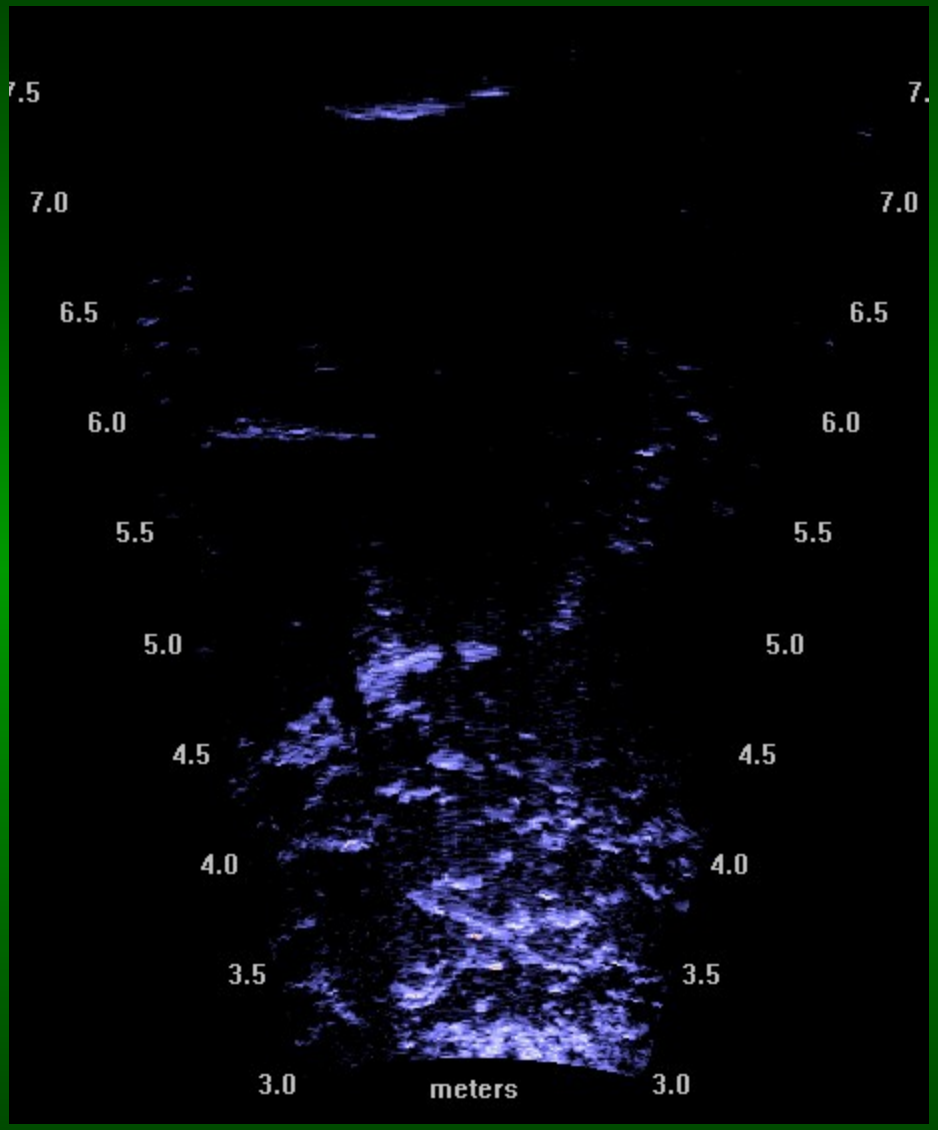
Pre-test Swimming



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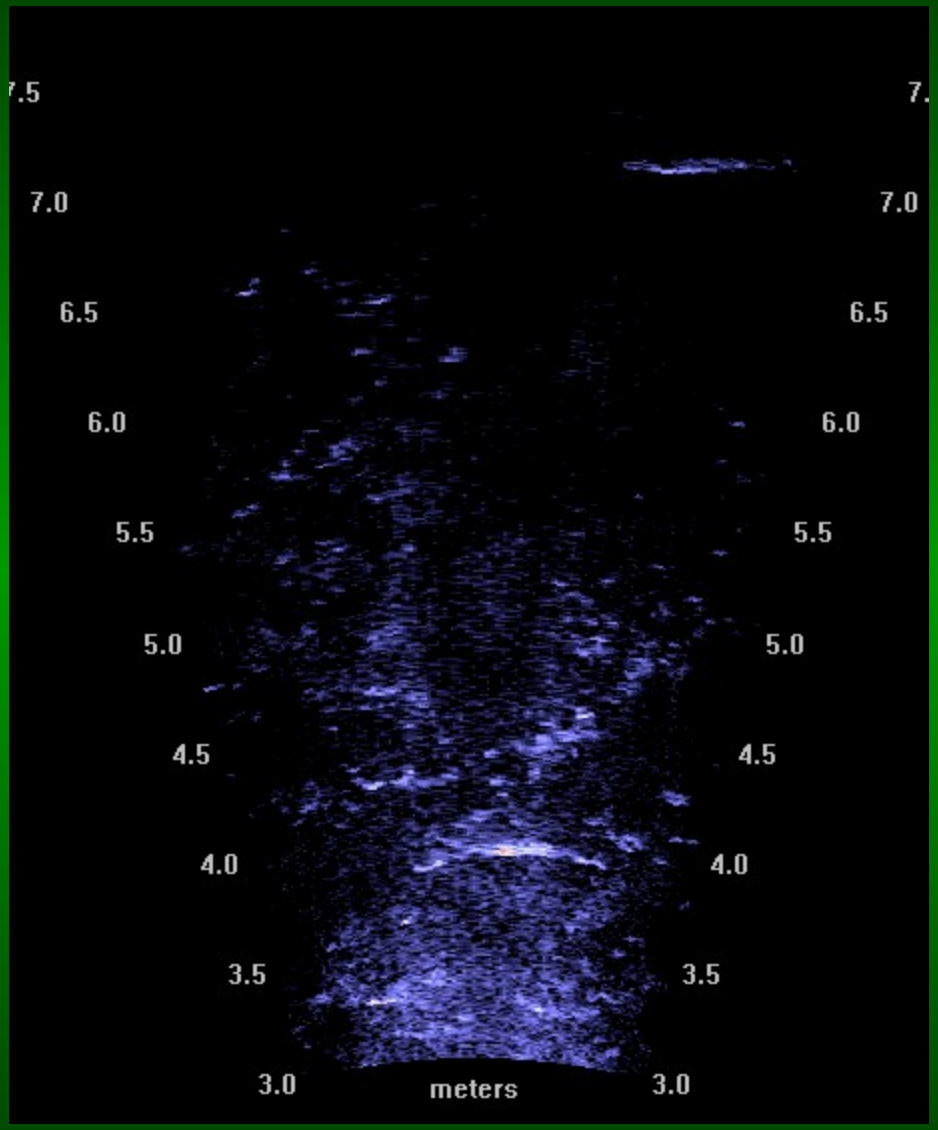
Maximum Flow Swimming



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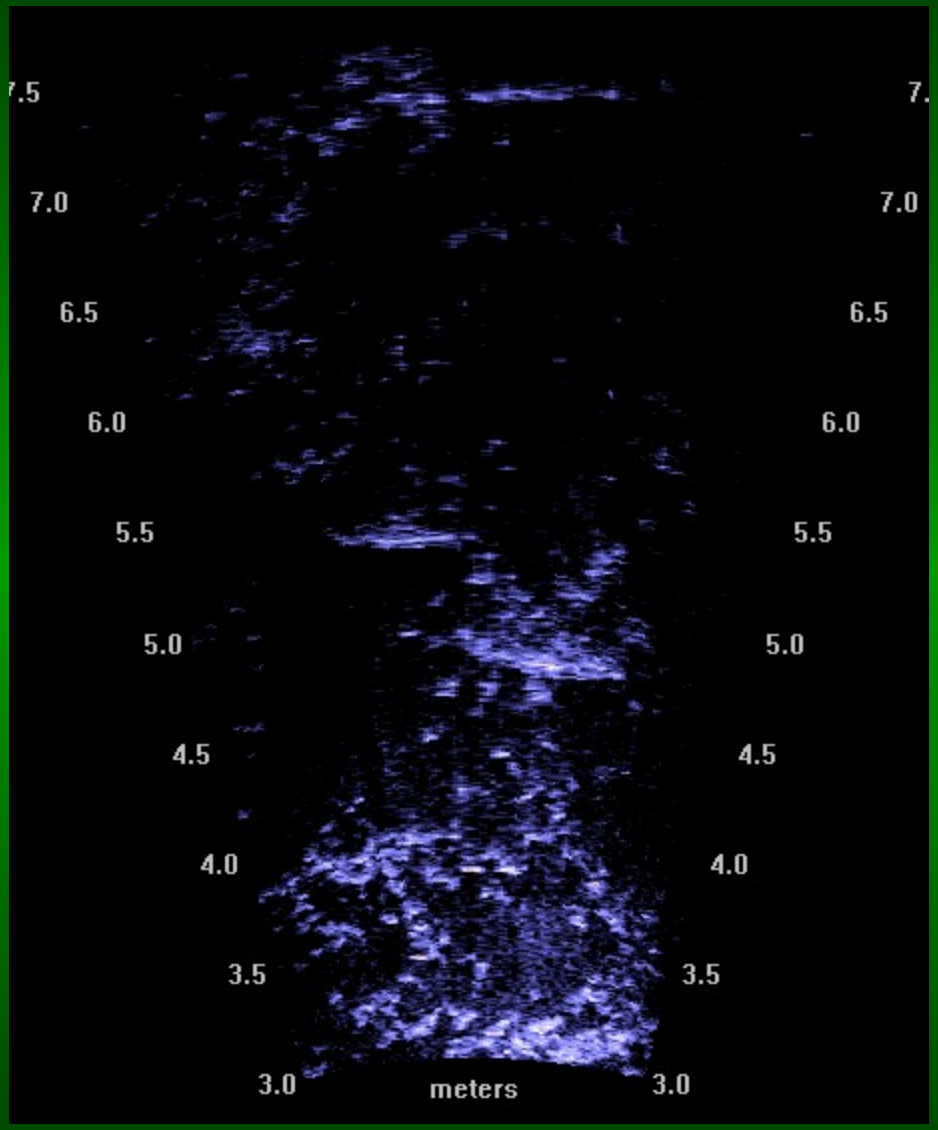
Pre-test Swimming



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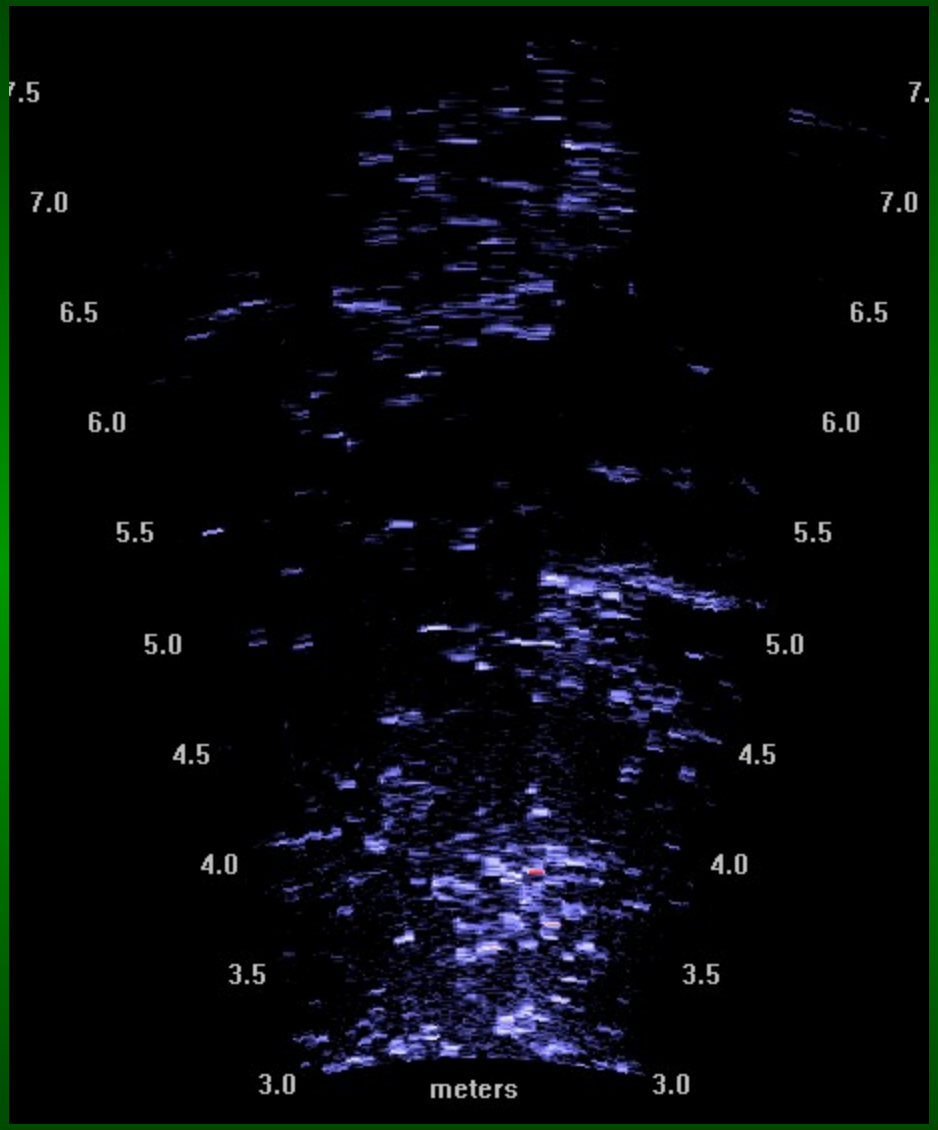
Maximum Flow Swimming



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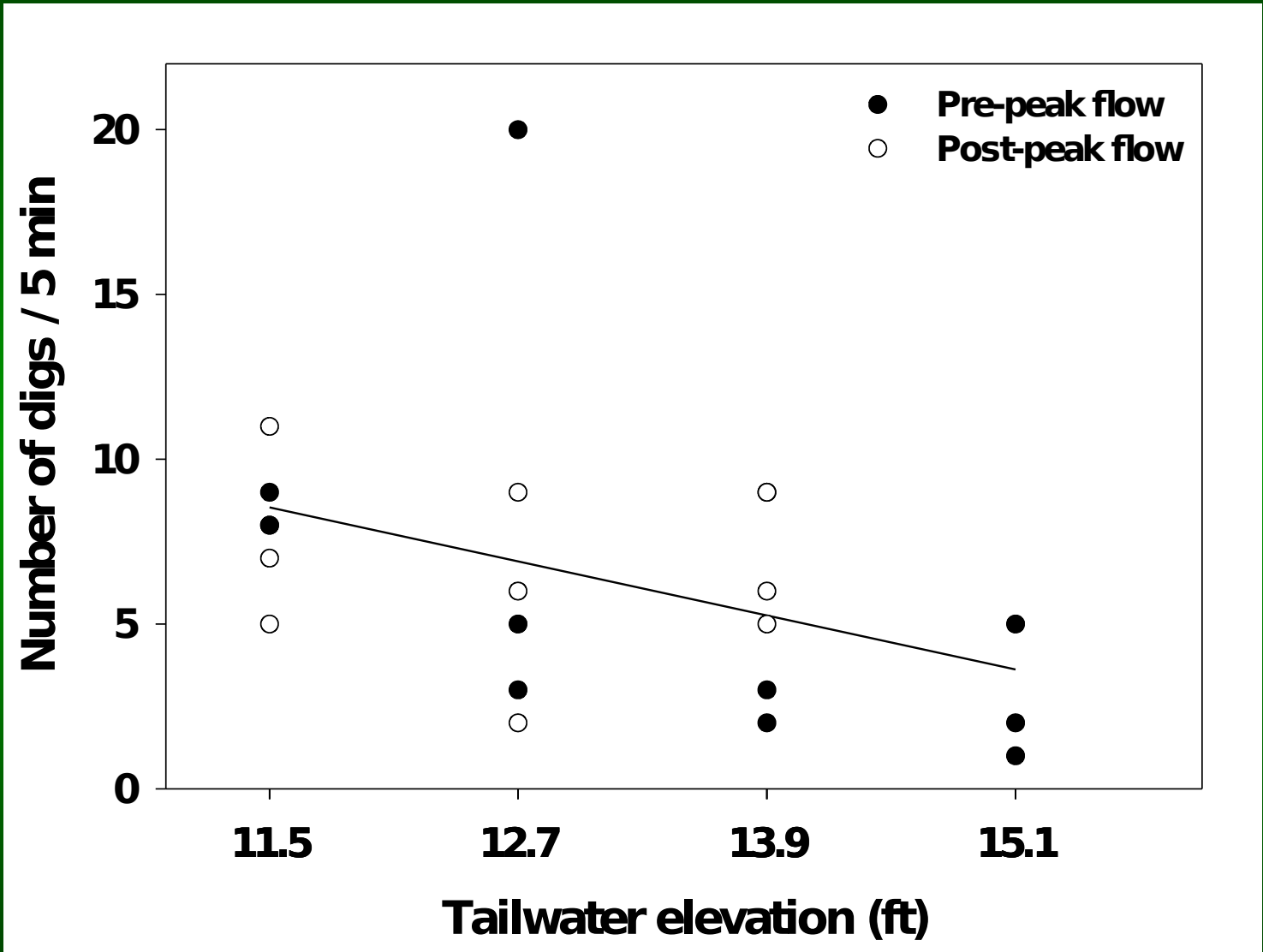
Effect of High-flow on chum salmon digging activity, 200



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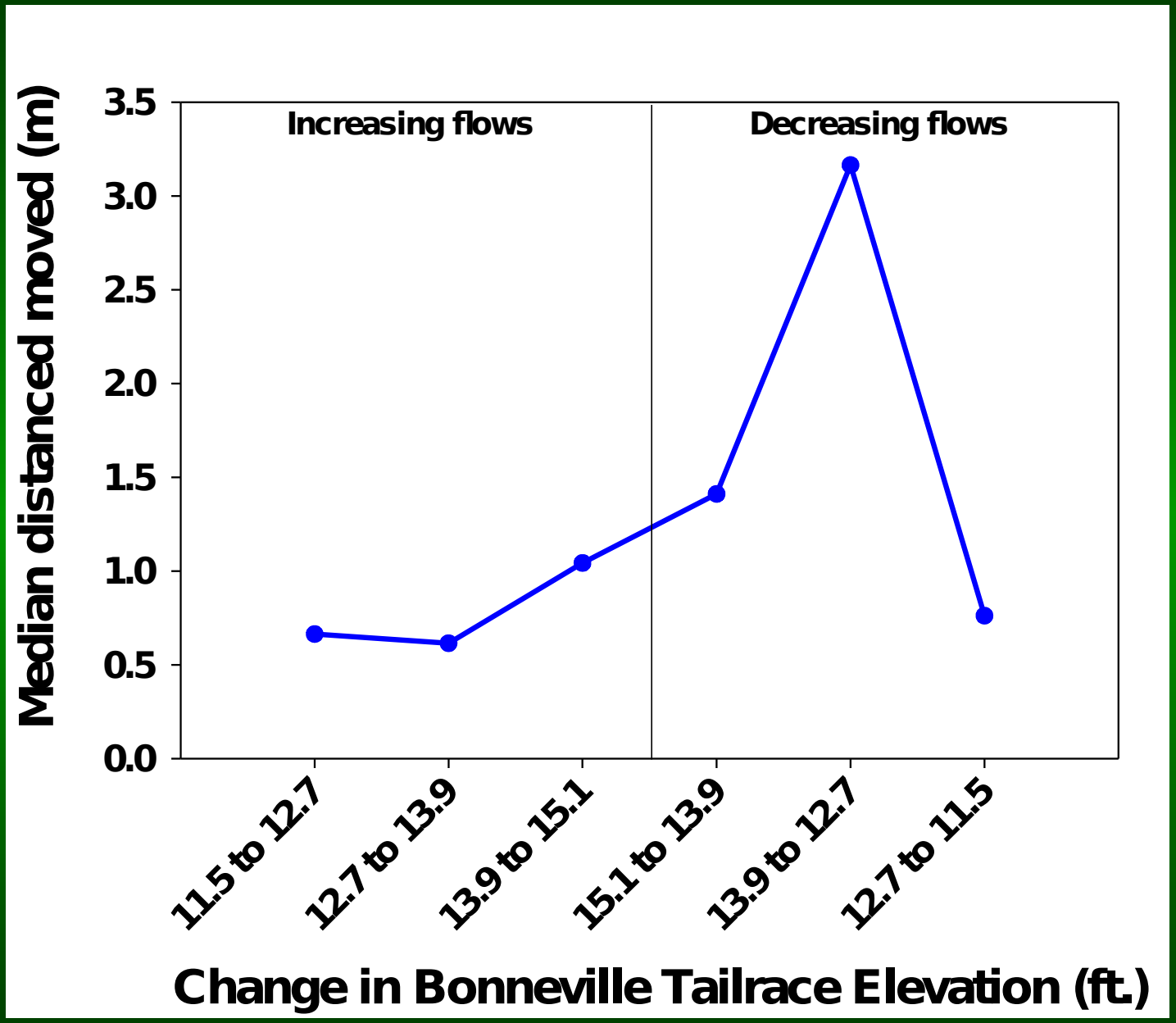
Increasing flows
Decreasing flows
Median distanced moved (m)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
11.5 to 12.7
12.7 to 13.9
13.9 to 15.1
15.1 to 13.9
13.9 to 12.7
12.7 to 11.5
Change in Bonneville Tailrace Elevation (ft.)

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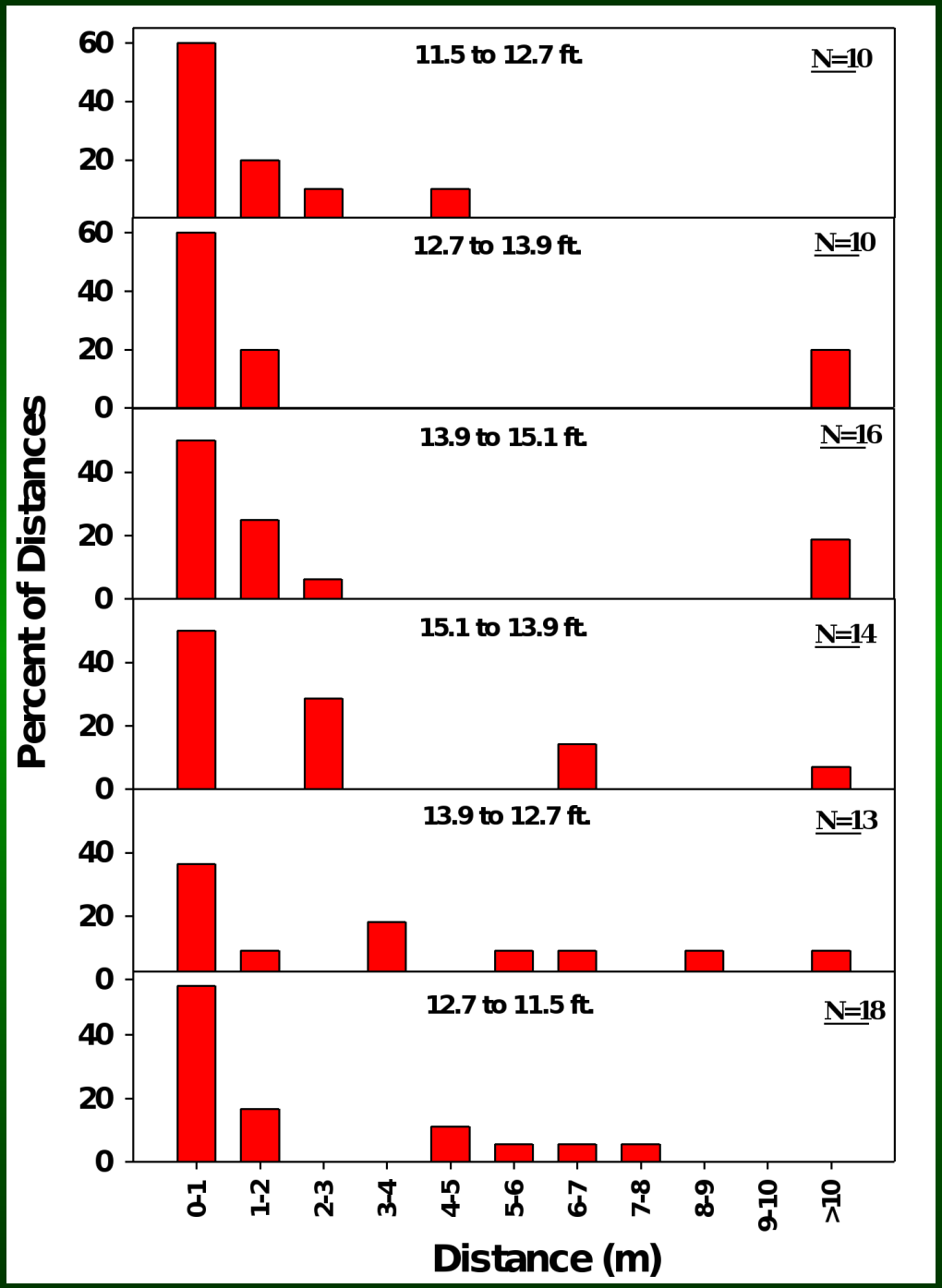
11.5 to 12.7 ft.
N=10
12.7 to 13.9 ft.
N=10
13.9 to 15.1 ft.
N=16
15.1 to 13.9 ft.
N=14
13.9 to 12.7 ft.
N=13
12.7 to 11.5 ft.
N=18
Percent of Distances
0
20
40
60
0-1
1-2
2-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
>10
Distance (m)

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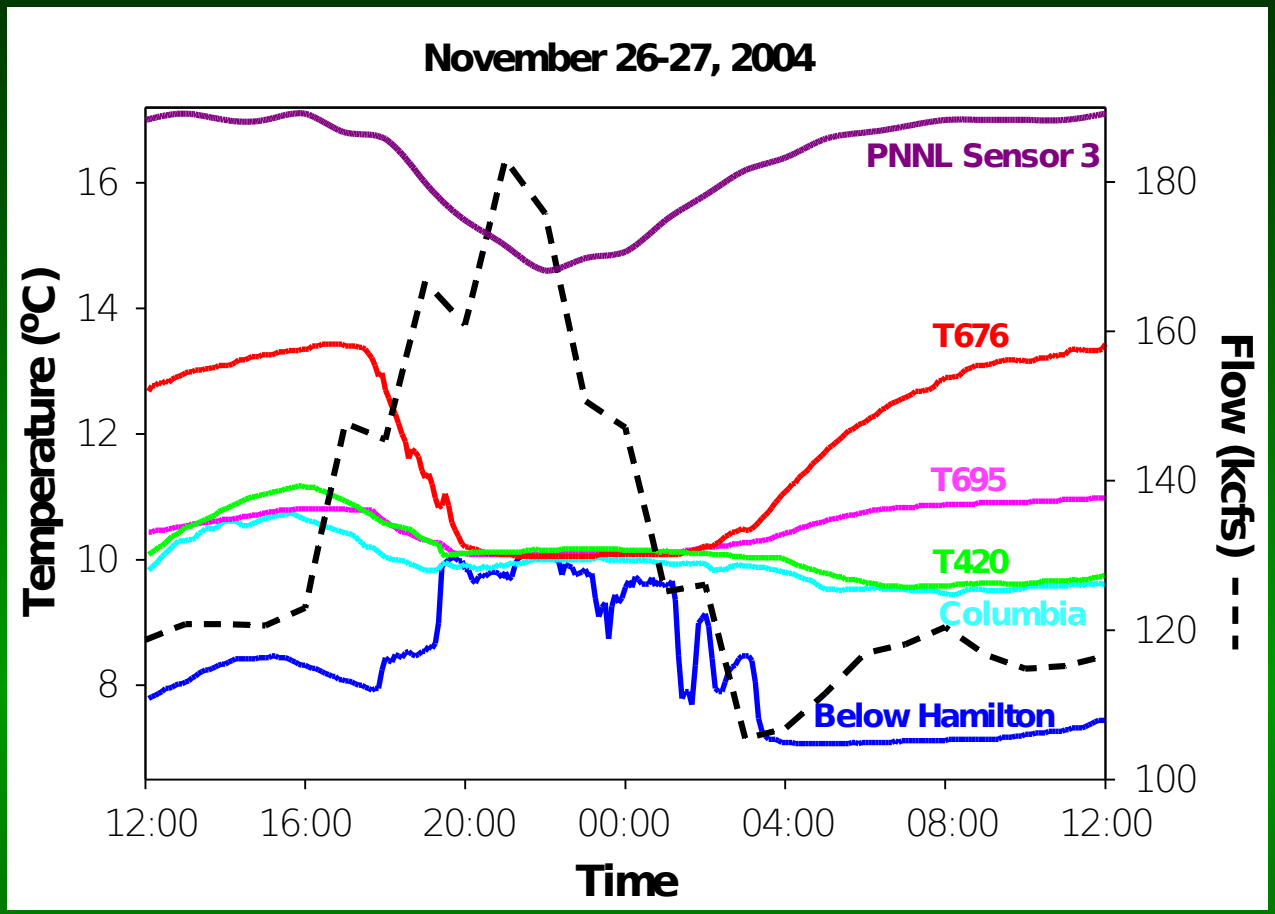
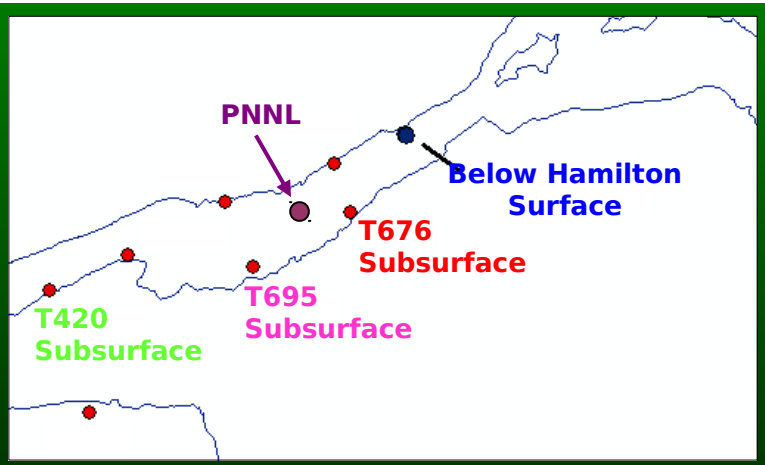
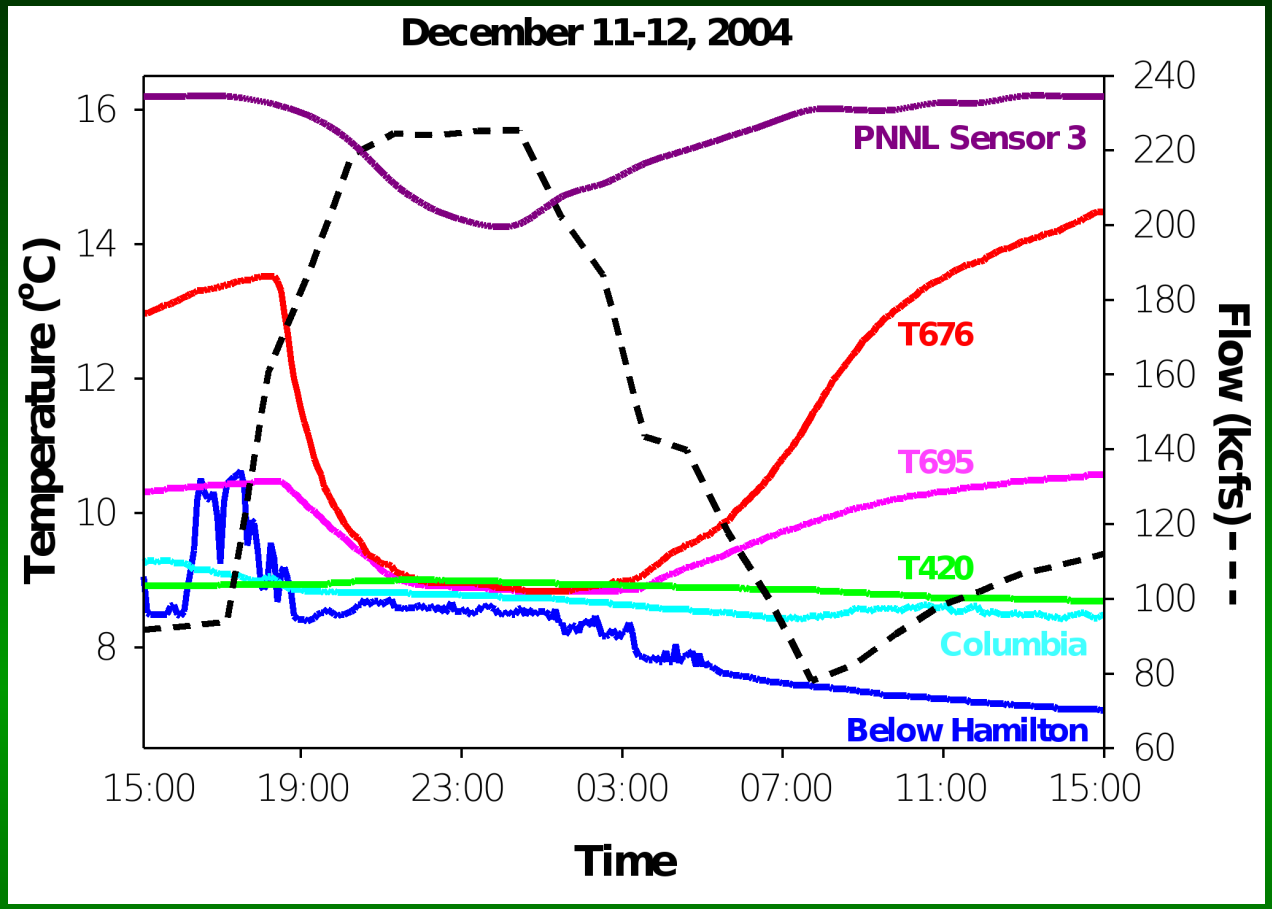
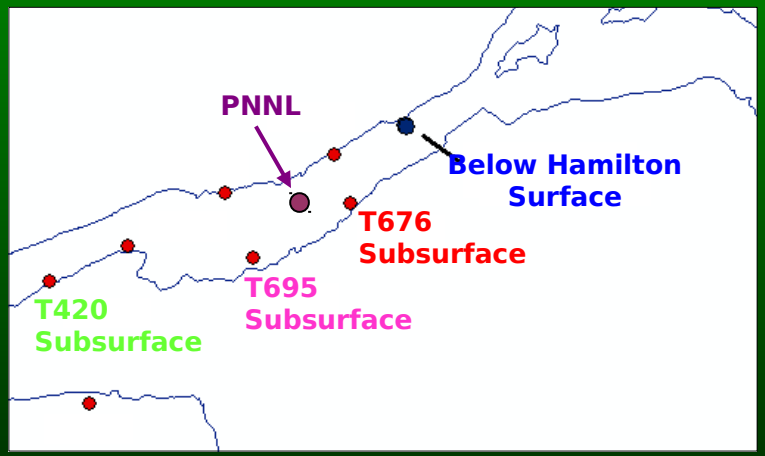

November 26-27, 2004
PNNL Sensor 3
T676
T695
T420
Columbia
Below Hamilton
Temperature (ºC)
Flow (kcfs)
16
14
12
10
8
180
160
140
120
100
12:00
16:00
20:00
00:00
04:00
08:00
12:00
Time


PNNL
Below Hamilton
Surface
T676
Subsurface
T695
Subsurface
T420
Subsurface

USGS


December 11-12, 2004
Temperature (°C)
Flow (kcfs) - - -
Time
PNNL Sensor 3
T676
T695
T420
Columbia
Below Hamilton
16
14
12
10
8
240
220
200
180
160
140
120
100
80
60
15:00
19:00
23:00
03:00
07:00
11:00
15:00


PNNL
Below Hamilton
Surface
T676
Subsurface
T695
Subsurface
T420
Subsurface

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Study Ended Prematurely Dec. 9th following flows of 243 kcfs

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Conclusions

- Elevated flow events may have temporary effect spawning behavior and subsurface bed tempera
- Acoustic noise issues need to be resolved and hydrophone deployment can be improved
- Relatively low spawner density in 2004 may hav affected the apparent lack of spawning activity higher riverbed elevations
- Study should be repeated in 2005

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